Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims regarding the present application. In reading this, text added by the amendment is underlined and canceled text appears in ~~strikethrough~~.

1. (Currently Amended) An apparatus for preventing cracking of a liquid system, comprising:
at least one heat exchanger;
at least one inlet port extending through a first opening for conveying a fluid to a plurality of channels and passages;
at least one outlet port extending through a second opening for discharging the fluid from the plurality of channels and passages; and
one or more compressible objects coupled to the inlet and outlet ports in an unpressured condition such that the compressible objects reduce a volume of the inlet port and the outlet port and further wherein pressure exerted on the compressible object increases a volume of the inlet port and the outlet port;
wherein, the heat exchanger is configured so that the fluid in the inlet port and the outlet port freezes later than the fluid elsewhere in the heat exchanger, and for freezing to advance towards the one or more compressible objects.

2. (Original) The apparatus of claim 1, wherein the compressible objects accommodate a predetermined level of fluid expansion.

3. (Original) The apparatus of claim 2, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

4. (Original) The apparatus of claim 1, wherein the compressible objects being capable of contracting and expanding between a minimum volume and a maximum volume.

5. (Original) The apparatus of claim 1, wherein the compressible objects being secured within the inlet port and the outlet port.

6. (Original) The apparatus of claim 1, wherein the compressible objects are confined within the inlet port and the outlet port.

7. (Original) The apparatus of claim 1, wherein the compressible objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

8. (Original) The apparatus of claim 7, wherein the sponge or foam is hydrophobic.

9. (Original) The apparatus of claim 1, wherein the compressible object is encapsulated in a gas or liquid impermeable package.

10. (Original) The apparatus of claim 9, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

11. (Original) The apparatus of claim 9, wherein the package has a hydrophilic surface or coating.

12. (Original) The apparatus of claim 9, wherein the package is formed of plastic material.

13. (Previously Presented) The apparatus of claim 12, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, and PVC.

14. (Withdrawn) An apparatus for preventing cracking of a liquid system, comprising:
at least one heat exchanger having a top element and a bottom element;
a plurality of channels and passages formed within the bottom element to provide flow of a fluid therethrough; and
one or more compressible objects positioned within one or more of the channels and passages such that in an uncompressed state the compressible objects reduce a volume of each of the channels and passages having compressible objects and further wherein under pressure exerted within the channels and passages the compressible objects are compressed to increase the volume of each of the channels and passages.

15. (Withdrawn) The apparatus of claim 14, wherein the compressible objects accommodate a predetermined level of fluid expansion.

16. (Withdrawn) The apparatus of claim 15, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

17. (Withdrawn) The apparatus of claim 14, wherein the compressible objects being capable of contracting and expanding between a minimum volume and a maximum volume.

18. (Withdrawn) The apparatus of claim 14, wherein the compressible objects being positioned with a portion of the top element.

19. (Withdrawn) The apparatus of claim 14, wherein the compressible objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

20. (Withdrawn) The apparatus of claim 14, wherein the compressible objects are encapsulated in a gas or liquid impermeable package.

21. (Withdrawn) The apparatus of claim 20, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

22. (Withdrawn) The apparatus of claim 20, wherein the package has a hydrophilic surface or coating.

23. (Withdrawn) The apparatus of claim 20, wherein the package is formed of plastic material.

24. (Withdrawn) The apparatus of claim 23, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, PVC, or other suitable plastic materials.

25. (Currently Amended) An apparatus for preventing cracking of a liquid system, comprising:
an enclosure; and

one or more compressible objects immersed in the enclosure;

wherein, the enclosure is configured to cause a fluid to begin to freeze at one or more locations in the enclosure, and for freezing to advance towards the one or more compressible objects.

26. (Original) The apparatus of claim 25, wherein the objects accommodate a predetermined level of fluid expansion.

27. (Original) The apparatus of claim 26, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

28. (Original) The apparatus of claim 25, wherein the objects having a size and volume proportion to an amount of fluid in the enclosure.

29. (Original) The apparatus of claim 25, wherein the objects are a hydrophobic foam.

30. (Original) The apparatus of claim 25, wherein the object are a hydrophobic sponge.

31. (Original) The apparatus of claim 25, wherein the objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

32. (Original) The apparatus of claim 25, wherein the objects are encapsulated in a gas or liquid impermeable package.

33. (Original) The apparatus of claim 32, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

34. (Original) The apparatus of claim 32, wherein the package is formed of plastic material.

35. (Previously Presented) The apparatus of claim 34, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, and PVC.

36. (Withdrawn) An apparatus for preventing cracking of a liquid system, comprising:

a housing having at least one inlet chamber and at least one outlet chamber; and one or more compressible objects immersed in the inlet and outlet chambers.

37. (Withdrawn) The apparatus of claim 36, wherein the objects accommodate a predetermined level of fluid expansion.

38. (Withdrawn) The apparatus of claim 37, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

39. (Withdrawn) The apparatus of claim 36, wherein the objects having a size and volume proportion to an amount of fluid in the chambers.

40. (Withdrawn) The apparatus of claim 36, wherein the objects are a hydrophobic foam.

41. (Withdrawn) The apparatus of claim 36, wherein the objects are a hydrophobic sponge.

42. (Withdrawn) The apparatus of claim 36, wherein the objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

43. (Withdrawn) The apparatus of claim 36, wherein the objects are encapsulated in a gas or liquid impermeable package.

44. (Withdrawn) The apparatus of claim 43, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

45. (Withdrawn) The apparatus of claim 43, wherein the package is formed of plastic material.

46. (Withdrawn) The apparatus of claim 45, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, PVC, or other suitable plastic materials.

47. (Currently Amended) A method of preventing cracking of a liquid system, the system including one or more pumps and one or more heat exchangers, the method comprising the steps of:
providing an enclosure; ~~and~~
configuring the enclosure to cause a fluid to begin to freeze at one or more locations in the enclosure, and for freezing to advance towards other locations in the enclosure; and
immersing one or more compressible objects in the enclosure at the other locations.

48. (Original) The method of claim 47, wherein the objects accommodate a predetermined level of fluid expansion.

49. (Original) The method of claim 48, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

50. (Original) The method of claim 47, wherein the objects having a size and volume proportion to an amount of fluid in the enclosure.

51. (Original) The method of claim 47, wherein the objects are a hydrophobic foam.

52. (Original) The method of claim 47, wherein the objects are a hydrophobic sponge.

53. (Original) The method of claim 47, wherein the objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

54. (Original) The method of claim 47, wherein the objects are encapsulated in a gas or liquid impermeable package.

55. (Original) The method of claim 54, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

56. (Original) The method of claim 54, wherein the package is formed of plastic material.

57. (Previously Presented) The method of claim 56, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, and PVC.

58. (Withdrawn) A method of preventing cracking of a liquid system, the method comprising the steps of:
providing a housing having at least one inlet chamber and at least one outlet chamber; and
immersing one or more compressible objects in the inlet and outlet chambers

59. (Withdrawn) The method of claim 58, wherein the objects accommodate a predetermined level of fluid expansion.

60. (Withdrawn) The method of claim 59, wherein the expansion occurs upon change of phase of an enclosed material from liquid to solid.

61. (Withdrawn) The method of claim 59, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

62. (Withdrawn) The method of claim 58, wherein the objects having a size and volume proportion to an amount of fluid in the chambers.

63. (Withdrawn) The method of claim 58, wherein the objects are a hydrophobic foam.

64. (Withdrawn) The method of claim 58, wherein the objects are a hydrophobic sponge.

65. (Withdrawn) The method of claim 58, wherein the objects are made of one of the following: sponge, foam, air-filled bubbles, or balloons.

66. (Withdrawn) The method of claim 58, wherein the objects are encapsulated in a gas or liquid impermeable package.

67. (Withdrawn) The method of claim 66, wherein the package is formed of metallic barrier material or metallized plastic sheet material.

68. (Withdrawn) The method of claim 66, wherein the package is formed of plastic material.

69. (Withdrawn) The method of claim 68, wherein the plastic material is selected from the group teflon, mylar, PET, PEN, PVC, or other suitable plastic materials.

70. (Currently Amended) An apparatus for preventing cracking of a liquid system, the system including one or more pumps and one or more heat exchangers, comprising an enclosure, wherein the enclosure being capable of contracting and expanding between a minimum volume condition and a maximum volume condition with fluid expansion during freezing, and further wherein the enclosure is configured to cause a fluid to begin to freeze at one or more locations in the enclosure, and for freezing to advance towards other locations in the enclosure.

71. (Withdrawn) An apparatus for preventing cracking in a pump, comprising:
a housing having at least one inlet chamber and at least one outlet chamber, the inlet and outlet chambers having a relatively narrowed central portion and substantially identical expanded end portions; and
means for initiating freezing from the narrowed central portion to the expanded end portions.

72. (Withdrawn) The apparatus of claim 71, wherein the means for initiating comprises at least one metallic insert mounted at a location in at least one of the inlet and outlet chambers.

73. (Withdrawn) The apparatus of claim 72, wherein the metallic insert is made of one of the following: copper, gold, silver, or a material of high thermal conductivity, such as silicon, aluminum, or a metal.

74. (Withdrawn) The apparatus of claim 72, wherein the metallic insert is coated with nickel or copper.

75. (Withdrawn) A method of preventing cracking in a pump, the method comprising the steps of:
providing a housing having at least one inlet chamber and at least one outlet chamber, the inlet and outlet chambers having a relatively narrowed central portion and substantially identical expanded end portions; and
providing means for initiating freezing from the narrowed central portion to the expanded end portions.

76. (Withdrawn) The method of claim 75, wherein the step of providing means for initiating comprises disposing at least one metallic insert at a location in at least one of the inlet and outlet chambers.

77. (Withdrawn) The method of claim 76, wherein the metallic insert is made of one of the following: copper, gold, silver, or a material of high thermal conductivity, such as silicon, aluminum, or a metal.

78. (Withdrawn) The apparatus of claim 76, wherein the metallic insert is coated with nickel or copper.

79. (Withdrawn) An apparatus for preventing cracking in a liquid system, comprising:
an enclosure; and
at least one air pocket disposed in the enclosure, the air pocket positioned farthest away from a location where liquid begins to freeze in the enclosure.

80. (Withdrawn) The apparatus of claim 79, wherein the air pocket having a volume proportion to an amount of fluid in the enclosure.

81. (Withdrawn) The apparatus of claim 79, wherein the air pocket accommodates a predetermined level of fluid expansion .

82. (Withdrawn) The apparatus of claim 81, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

83. (Withdrawn) An apparatus for preventing cracking of a liquid system, comprising:
a housing having at least one inlet chamber and at least one outlet chamber; and
at least one air pocket disposed in the inlet and outlet chambers, the air pocket positioned farthest away from a location where liquid begins to freeze in the chambers.

84. (Withdrawn) The apparatus of claim 83, wherein the air pocket having a volume proportional to an amount of fluid in the chambers.

85. (Withdrawn) The apparatus of claim 84, wherein the proportional is between 5% and 25%.

86. (Withdrawn) The apparatus of claim 83, wherein the air pocket accommodates a predetermined level of fluid expansion .

87. (Withdrawn) The apparatus of claim 86, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

88. (Withdrawn) A method of preventing cracking of a liquid system, the method comprising the steps of:
providing an enclosure; and
disposing at least one air pocket in the enclosure, the air pocket positioned farthest away from a location where liquid begins to freeze in the enclosure.

89. (Withdrawn) The method of claim 88, wherein the air pocket having a volume proportion to an amount of fluid in the enclosure.

90. (Withdrawn) The method of claim 88, wherein the air pocket accommodates a predetermined level of fluid expansion.

91. (Withdrawn) The method of claim 90, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

92. (Withdrawn) A method of preventing cracking of a liquid system, the method comprising the steps of:
providing a housing having at least one inlet chamber and at least one outlet chamber; and
disposing at least one air pocket in the inlet and outlet chambers, the air pocket positioned farthest away from a location where liquid begins to freeze in the chambers.

93. (Withdrawn) The method of claim 92, wherein the air pocket having a volume proportion to an amount of fluid in the chambers.

94. (Withdrawn) The method of claim 92, wherein the air pocket accommodates a predetermined level of fluid expansion.

95. (Withdrawn) The method of claim 94, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

96. (Withdrawn) An apparatus for preventing cracking of a liquid system, comprising:
an enclosure for holding liquid having a plurality of walls; and
at least one flexible object coupled to form a portion of at least one wall of the enclosure such that pressure exerted on the flexible object increases a
volume of the enclosure.

97. (Withdrawn) The apparatus of claim 96, wherein the flexible object accommodates a predetermined level of fluid expansion.

98. (Withdrawn) The apparatus of claim 97, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

99. (Withdrawn) The apparatus of claim 96, wherein the flexible object being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

100. (Withdrawn) The apparatus of claim 96, wherein the flexible object being secured within the enclosure.

101. (Withdrawn) The apparatus of claim 96, wherein the flexible object is made of one of the following: rubber, plastic or foam.

102. (Withdrawn) The apparatus of claim 96, wherein the enclosure is a tubing.

103. (Withdrawn) An apparatus for preventing cracking of a liquid system, comprising:
a housing for holding liquid having at least one inlet chamber and at least one outlet chamber structure; and
at least one flexible object coupled to form a portion of at least one of the inlet and outlet chambers such that pressure exerted on the flexible object
increases a volume of the housing.

104. (Withdrawn) The apparatus of claim 103, wherein the flexible object accommodates a predetermined level of fluid expansion.

105. (Withdrawn) The apparatus of claim 104, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

106. (Withdrawn) The apparatus of claim 103, wherein the flexible object being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

107. (Withdrawn) The apparatus of claim 103, wherein the flexible object being secured within the inlet and outlet chambers.

108. (Withdrawn) The apparatus of claim 103, wherein the flexible object is made of one of the following: rubber, plastic or foam.

109. (Withdrawn) A method of preventing cracking of a liquid system, the method comprising the steps of:
providing an enclosure for holding liquid having a plurality of walls; and
disposing at least one flexible object to form a portion of at least one wall of the enclosure such that pressure exerted on the flexible object increases a volume of the enclosure, the flexible object accommodating a predetermined level of fluid expansion.

110. (Withdrawn) The method of claim 109, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

111. (Withdrawn) The method of claim 109, wherein the flexible object being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

112. (Withdrawn) The method of claim 109, wherein the flexible object is made of one of the following: rubber, plastic or foam.

113. (Withdrawn) The method of claim 109, wherein the enclosure is a tubing.

114. (Withdrawn) A method of preventing cracking of a liquid system, the method comprising the steps of:
providing a housing for holding liquid having at least one inlet chamber and at least one outlet chamber; and
disposing at least one flexible object to form a portion of at least one of the inlet and outlet chambers such that pressure exerted on the flexible object increases a volume of the housing, the flexible objects accommodating a predetermined level of fluid expansion.

115. (Withdrawn) The method of claim 114, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

116. (Withdrawn) The method of claim 114, wherein the flexible object being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

117. (Withdrawn) The method of claim 114, wherein the flexible object is made of one of the following: rubber, plastic or foam.

118. (Withdrawn) An apparatus for preventing cracking in a pump, comprising:
a housing having at least one inlet chamber and at least one outlet chamber; and
a plurality of spaced apart flexible objects coupled to form a portion of at least one wall of the housing such that pressure exerted on the plurality of spaced apart flexible objects increases a volume of the housing.

119. (Withdrawn) The apparatus of claim 118, wherein the flexible objects accommodate a predetermined level of fluid expansion.

120. (Withdrawn) The apparatus of claim 119, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

121. (Withdrawn) The apparatus of claim 118, wherein the flexible objects being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

122. (Withdrawn) The apparatus of claim 118, wherein the pump is electro-osmotic.

123. (Withdrawn) The apparatus of claim 118, wherein the flexible objects are made of elastomer hinges.

124. (Withdrawn) The apparatus of claim 118, wherein the flexible objects are made of one of the following: plastic, rubber, or foam.

125. (Withdrawn) The apparatus of claim 118, wherein the flexible objects are fastened to rigid plates of the housing.

126. (Withdrawn) A method of preventing cracking in a pump, the method comprising the steps of:
providing a housing having at least one inlet chamber and at least one outlet chamber; and
disposing a plurality of spaced apart flexible objects to form at least one wall of the housing such that pressure exerted on the plurality of spaced apart flexible objects increase a volume of the housing, the plurality of spaced apart flexible objects accommodating a predetermined level of fluid expansion.

127. (Withdrawn) The method of claim 126, wherein the predetermined level of fluid expansion is between 5 to 25 percent.

128. (Withdrawn) The method of claim 126, wherein the flexible objects being capable of contracting and expanding between a minimum volume condition and a maximum volume condition.

129. (Withdrawn) The method of claim 126, wherein the pump is electro-osmotic.

130. (Withdrawn) The method of claim 126, wherein the flexible objects are made of elastomer hinges.

131. (Withdrawn) The method of claim 126, wherein the flexible objects are made of one of the following: plastic, rubber or foam.

132. (Withdrawn) The method of claim 126, wherein the flexible objects are fastened to rigid plates of the housing.

New Claims

133. (New) A method of preventing cracking of a liquid system, the system including one or more pumps and one or more heat exchangers, the method comprising the steps of:

providing an enclosure; and

immersing one or more compressible objects in the enclosure, wherein the one or more compressible objects are not covered by a separate membrane.

134. (New) An apparatus for preventing cracking of a liquid system, comprising:

at least one heat exchanger;

at least one inlet port extending through a first opening for conveying a fluid to a plurality of channels and passages;

at least one outlet port extending through a second opening for discharging the fluid from the plurality of channels and passages; and

one or more compressible objects each coupled to at least one of the inlet port and outlet port in an unpressured condition such that the compressible objects reduce a volume of the inlet port and the outlet port and further wherein pressure exerted on the compressible object increases a volume of the inlet port and the outlet port, wherein the one or more compressible objects are not covered by a separate membrane.

135. (New) An apparatus for preventing cracking of a liquid system, comprising:

at least one heat exchanger including a plurality of microchannels;

at least one inlet port extending through a first opening for conveying a fluid to the plurality of microchannels;

at least one outlet port extending through a second opening for discharging the fluid from the plurality of microchannels; and

one or more compressible objects each coupled to at least one of the inlet port and outlet port in an unpressured condition such that the compressible objects reduce a volume of the inlet port and the outlet port and further wherein pressure exerted on the compressible object increases a volume of the inlet port and the outlet port;

wherein, the heat exchanger is configured so that fluid within the plurality of microchannels freezes before fluid within the outlet port and the inlet port.